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(12) # Utility Patent Specification

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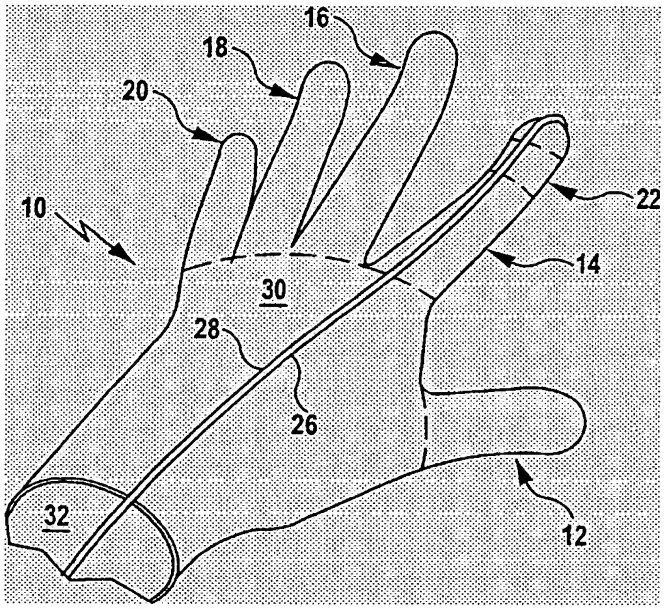
The following information is taken from the documents submitted by the applicant

(54) Title: **Surgical finger cap**

(57) First claim: Surgical finger cap (22) for at least partially covering a finger, characterized in that the finger cap (22) contains at least one electrical switching element (24) for opening or closing an electric circuit (26, 28; 60, 62) of an electrosurgical apparatus (44, 50).



Description

[0001] The invention involves a surgical finger cap for at least partially covering a finger.

[0002] Surgical finger caps of the type mentioned in the introduction are known, for example, as part of surgical gloves that are worn by physicians during surgical interventions. During surgical interventions that use electrosurgical apparatus, for example high-frequency instruments for coagulation of tissue, a foot switch is normally employed, which the surgeon actuates several times during the operation. A drawback of this type of foot switch is that the surgeon has to look at the floor frequently during the surgical intervention so that he knows where the switch is located and that he can actuate it accurately.

[0003] A surgical glove is known from US 3,845,771, which is equipped with one or more circuit-board conductors, via which electrosurgical instruments can be actuated, specifically so that the circuit-board conductor of the glove is connected directly to the electrically conductive instrument so that an electric circuit can be completed.

[0004] A drawback of such an arrangement is that in the event of unintentional contact between a finger of the glove that is equipped with a printed circuit and the instrument, a current, especially a high-frequency current, can flow immediately.

[0005] It is therefore the purpose of the invention in question to improve a surgical finger cap of the type described in the introduction, so that a simple and accurate actuation of electrosurgical apparatus by a surgeon is possible.

[0006] In accordance with the invention, this purpose is realized with a surgical finger cap of the type described in the introduction in that the finger cap contains at least one electrical switching element for opening or closing an electric circuit of an electrosurgical apparatus.

[0007] With such an electrical switching element, electric circuits, for example control circuits and/or open circuits, can be opened and closed in a simple manner. In particular, no direct current flow from the switching element to the instrument is required, so an unintentional current flow from the finger cap to the instrument is impossible when the finger cap in accordance with the invention is used. Such uncontrolled current flows can thus be safely prevented. In any event, a surgeon can open and close an electric current of an electrosurgical apparatus in a simple manner without being distracted from the surgical intervention by looking for an actuating switch. In particular, the finger cap can be constructed so that it surrounds a finger like a ring, so that it is kept securely on the finger.

[0008] The finger cap is preferably part of a surgical finger stall. This increases the ease of handling of the finger cap and ensures its secure hold on a surgeon's finger. In particular, it retains its position in a desired manner.

[0009] It is favorable if the finger cap is part of a surgical glove. In this manner a surgeon can put on the glove and at the same time immediately has the option of using the switching element to open or close an electric circuit of the instrument being used.

[0010] In accordance with a preferred embodiment of the invention, the surgical glove or the surgical finger stall can comprise at least one electrical supply conductor for the at least one switching element. In this manner a muddling of supply conductors in the area of the surgeon's hands or in the operating area can be effectively avoided.

[0011] It is also conceivable that the finger cap is part of a thimble.

[0012] The finger cap is preferably constructed in a tubular shape. In this manner it can be pulled onto a finger simply and securely.

[0013] In accordance with a preferred embodiment of the invention, the length of the finger cap can correspond approximately to its diameter. A switching element can be arranged on such a finger cap in a desired manner and fixed on various sites of the same finger, depending on the user's preference.

[0014] The finger cap is especially simple to put on if it is elastic.

[0015] To prevent the finger cap from slipping, the finger cap is preferably closed at one end. In this way the finger cap can slide down a finger only until the finger makes contact with the closed end of the finger cap.

[0016] It is especially advantageous if the at least one switching element is a pressure-activated switch or pushbutton. An electric circuit can be opened or closed by a simple exertion of pressure on the part of the operator via a finger that is wearing the finger cap. In so doing, it does not matter if the switching element is pressed against the instrument or the device that is intended to be actuated, or against other objects.

[0017] The at least one switching element is advantageously an ohmic switch or pushbutton. Such a switch or pushbutton is especially simple to manufacture and can be attached to a finger cap in an especially small design.

[0018] In order to actuate an electric circuit also in a contact-free manner, it is favorable if the at least one switching element can be actuated capacitively or inductively. A switching operation can thereby be initiated

if the switching element enters the proximity of capacitive or inductive elements. This is particularly an advantage if especially thick gloves or finger caps are used. In particular, the switching element can be arranged on the inside of the finger cap, where it is normally automatically protected against external influences. Furthermore, such switching elements can be of very small construction, require no movable parts and are very sensitive.

[0019] An especially simple design is produced if the at least one switching element comprises a magnetic field sensor. Such sensors are especially small and can be actuated by means of small magnets or ferromagnetic components.

[0020] It is especially advantageous if the magnetic field sensor is a Hall sensor. Basically, the switching element can be designed so that it switches the electric circuit on or off directly.

[0021] It is favorable if an actuator comprising the at least one switching element is provided for switching the electric circuit of the apparatus on and off. This makes it possible to arrange only the switching element on the finger cap, while larger and heavier components of the circuit are arranged in an area of the operating room where they do not interfere with a surgical intervention.

[0022] So that the finger cap can be used in high-frequency surgical interventions, it is advantageous if the actuator is a high-frequency activating unit.

[0023] In accordance with a preferred invention, the electric circuit of the electrosurgical apparatus can be a control circuit and/or feedback control circuit or an open circuit. As an example, the switching element can actuate a control circuit, which in turn actuates an open circuit of the instrument. In this way, very small currents sufficiently effect a switching operation. This increases the safety of the person wearing the finger cap.

[0024] It is advantageous if the electrosurgical apparatus is an electrosurgical instrument or a medical or surgical instrument. It is especially conceivable that an operator controls not only one instrument, which is guided by the operator, but also additional medical or surgical instruments that are used in connection with a surgical intervention et al. It would be further conceivable that an operator is equipped with several finger caps so that several instruments could be actuated independent of each other in a simple manner.

[0025] The following description of preferred embodiments of the invention is intended for more detailed elucidation in connection with the drawing.

[0026] **Figure** 1 shows a surgical glove;

[0027] **Figure** 2 shows an enlarged detail of a finger of the surgical glove from **Figure** 1;

[0028] **Figure** 3 shows a diagram of the function of the surgical glove from **Figure** 1;

[0029] **Figure** 4 shows a sketched circuit diagram for a capacitive switching element;

[0030] **Figure** 5 shows a sketched circuit diagram for an inductive switching element; and

[0031] **Figure** 6 shows a sketched circuit diagram for a Hall sensor as switching element.

[0032] **Figure** 1 shows a surgical glove, indicated collectively by reference number **10**, which comprises five finger stalls **12**, **14**, **16**, **18** and **20**. Finger stall **12** functions to receive a thumb, finger stall **14** to receive an index finger, finger stall **16** to receive a middle finger, finger stall **18** to receive a ring finger and finger stall **20** to receive a little finger of a hand of an operator. The glove **10** shown in **Figure** 1 is constructed for a left hand; basically, it is also possible to manufacture a similar glove for a right hand.

[0033] All finger stalls **12** to **20** are constructed as a single unit with the glove **10**. The finger stall **14** has a closed finger cap **22** at its front end, which could also be constructed to be open, as shown by the dashed line, in the shape of a ring. The finger cap **22** is constructed as a single unit with the finger stall **14**. It contains a pressure-activated ohmic switch **24**, which is connected to two supply conductors **26** and **28**, which are fastened to the finger stall **14** and to the glove **10**. In **Figures** 1 to 3 the supply conductors **26** and **28** are arranged divergently on an outer surface **30** of the glove **10** and of the finger stall **14**; however, it would also be conceivable to arrange the supply conductors **26** and **28** divergently on the inside **32** of the glove **10** and of the finger stall **14**. Alternatively, the supply conductors **26** and **28** could also be recessed in the glove material, which is preferably an elastic plastic or latex.

[0034] As shown in the enlarged detail in **Figure** 2, the switch **24** comprises a pivoting actuating button **34** which has two contacts **36** and **38**, which in an actuated state become connected to circuit contacts **40** and **42**, arranged on free ends of supply conductors **26** and **28**, thereby making possible a current flow via the supply conductors **26** and **28**.

[0035] The use of the glove **10** is diagrammed is **Figure** 3. A surgical instrument in the form of endoscopic bipolar scissors, indicated collectively by reference number **44**, is held by a surgeon during a surgical intervention. Regardless of whether the surgeon holds the instrument **44** by its two branches **46** and **48** or elsewhere, he can, as an example, close a high-frequency electric circuit using the switch **24** arranged on the finger cap **22**, via which upon contact

with an instrument tip **56** in an operating area, which is not shown, tissue can be obliterated. If the surgeon presses the switch **24** against the instrument **44** at an arbitrary site, the contacts **36** and **38** are directed against the circuit contacts **40** and **42** so that the electric circuit is closed as desired.

[0036] In **Figures** 4 to 6 additional variants of switching elements are diagrammed, which are discussed in detail below.

[0037] A HF surgical instrument **50a**, diagrammed with a dashed line in **Figure** 4, is connected via supply conductors **26a** and **28a** to a capacitive switch **24a** in the form of a capacitor, arranged on a finger stall **14a**. A high-frequency surgical instrument **44a** has an additional capacitor **54a** and is provided collectively with a layer of insulation **52a** on its outer surface. The instrument **44a** is connected to the instrument **50a** via supply conductors **60a** and **62a**. Conducting a high-frequency current to an instrument tip **56a** of the instrument **44a** is achieved if a surgeon brings the finger stall **14a** containing the switch **24a** in the proximity of the capacitor **54a**. The instrument **50a** comprises a corresponding switch, with which a high-frequency current for the instrument **44a** is isolated, corresponding to a level set on a controller **58a**.

[0038] **Figure** 5 shows a third example of embodiment of a surgical finger stall **14b**, which has a capacitive switch **24b** in the form of a coil arranged on the finger stall **14b** or on a finger cap **22b**, which coil is connected to a high-frequency surgical instrument **50b** via supply conductors **26b** and **28b**. The instrument **50b** is connected via supply conductors **60b** and **62b** to a high-frequency surgical instrument **44b**, which can have an additional coil **64b**, which is switched between the supply conductors **60b** and **62b**. No direct ohmic contact is produced between the instrument **44b** covered with a layer of insulation **52b** and the switch **24b**. Bringing the switch **24b** near the instrument **44b** effects a change in the control current flowing through the switch **24b**, which activates or deactivates a high-frequency current in the instrument **24** so that a high-frequency current can or cannot be applied to tissue with the instrument tip **56b**. The level of the high-frequency current can be set on the instrument **50b** using the controller **58b**.

[0039] A third example of embodiment of a finger stall **14c** in accordance with the invention is shown in **Figure** 6. The finger stall **14c** comprises a magnetically sensitive switch **20c** in the form of a Hall sensor, which is connected via supply conductors **26c** and **28c** to a high-frequency surgical instrument **50c**, which comprises a control switch **68c**. The sensitivity of the switch **24c** can be set via a controller **58c**. A high-frequency surgical instrument **44c** is connected to the instrument **50c** via supply conductors **60c** and **62c**. The instrument **44c** has a small control magnet **66c**, which is not visibly integrated in the instrument **44c**. However, the instrument **46c** can be provided with a marking so that a surgeon can note the position of the control magnet **66c**. If the surgeon moves a finger surrounded by the finger stall **46c** in the direction of the control magnet **66c**, the correspondingly constructed control switch **68c** will apply a high-frequency current to the instrument **44c**, especially to its tip **46c**. If the surgeon removes the finger stall **14c** from the area of the control magnet **66c**, the control switch **68** will once again interrupt the high-frequency current to the instrument **44c**.

[0040] With all the proposed possible examples of embodiment of finger caps **22** and finger stalls **14**, electrosurgical instruments and devices can be actuated by a surgeon in a simple manner. Depending on the construction of the switching element, certain areas of the instrument to which a switch **24** must be moved or directed can be designated so as to actuate, for example, a control current for an actuator, with which an open circuit on the instrument **44** can be closed using the control device.

[0041] All proposed switching elements can be integrated in a finger cap **22**, in a finger stall or in a glove. The arrangement of the switch **24** on the finger stall **14** for the index finger of a surgeon is merely an example. Corresponding switches **24** can readily be provided on each of the finger stalls **12** to **20** of a glove, so that a surgeon can actuate several instruments simultaneously with one hand.

Protective claims

1. Surgical finger cap (**22**) for at least partially covering a finger, **characterized in that** the finger cap (**22**) contains at least one electrical switching element (**24**) for opening or closing an electric circuit (**26**, **28**; **60**, **62**) of an electrosurgical apparatus (**44**, **50**).

2. Finger cap according to Claim 1, characterized in that the finger cap (**22**) is part of a surgical finger stall (**14**).

3. Finger cap according to one of the Claims 1 or 2, characterized in that the finger cap (**22**) is part of a surgical glove (**10**).

4. Finger cap according to one of the Claims 2 or 3, characterized in that the surgical glove (**10**) or the surgical

finger stall (**14**) comprises at least one electrical supply conductor (**26, 28**) for the at least one switching element (**24**).

5. Finger cap according to one of the preceding claims, characterized in that the finger cap (**22**) is part of a thimble.

6. Finger cap according to one of the preceding claims, characterized in that the finger cap (**22**) is constructed in a tubular shape.

7. Finger cap according to one of the preceding claims, characterized in that the length of the finger cap (**22**) corresponds approximately to its diameter.

8. Finger cap according to one of the preceding claims, characterized in that the finger cap (**22**) is elastic.

9. Finger cap according to one of the preceding claims, characterized in that the finger cap (**22**) is closed at one end.

10. Finger cap according to one of the preceding claims, characterized in that the at least one switching element (**24**) is a pressure-activated switch or pushbutton.

11. Finger cap according to one of the preceding claims, characterized in that the at least one switching element (**24**) is an ohmic switch or pushbutton.

12. Finger cap according to one of the Claims 1 to 10, characterized in that the at least one switching element (**24**) is activated capacitively or inductively.

13. Finger cap according to Claim 12, characterized in that the at least one switching element (**24**) comprises a magnetic field sensor.

14. Finger cap according to Claim 13, characterized in that the magnetic field sensor (**24**) is a Hall sensor.

15. Finger cap according to one of the preceding claims, characterized in that an actuator (**50**) comprising the at least one switching element (**24**) is provided for switching the electric circuit of the electrosurgical apparatus on and off.

16. Finger cap according to Claim 15, characterized in that the actuator (**50**) is a high-frequency activating unit.

17. Finger cap according to one of the preceding claims, characterized in that the electric circuit (**26, 28; 60, 62**) of the electrosurgical apparatus (**50**) is a control circuit and/or feedback control circuit (**26, 28**) or an open circuit (**60, 62**).

18. Finger cap according to one of the preceding claims, characterized in that the electrosurgical apparatus (**44; 50**) is an electrosurgical instrument (**44**) or a medical or surgical instrument (**50**).

Three pages of drawings are appended

Appended drawings

FIG.1

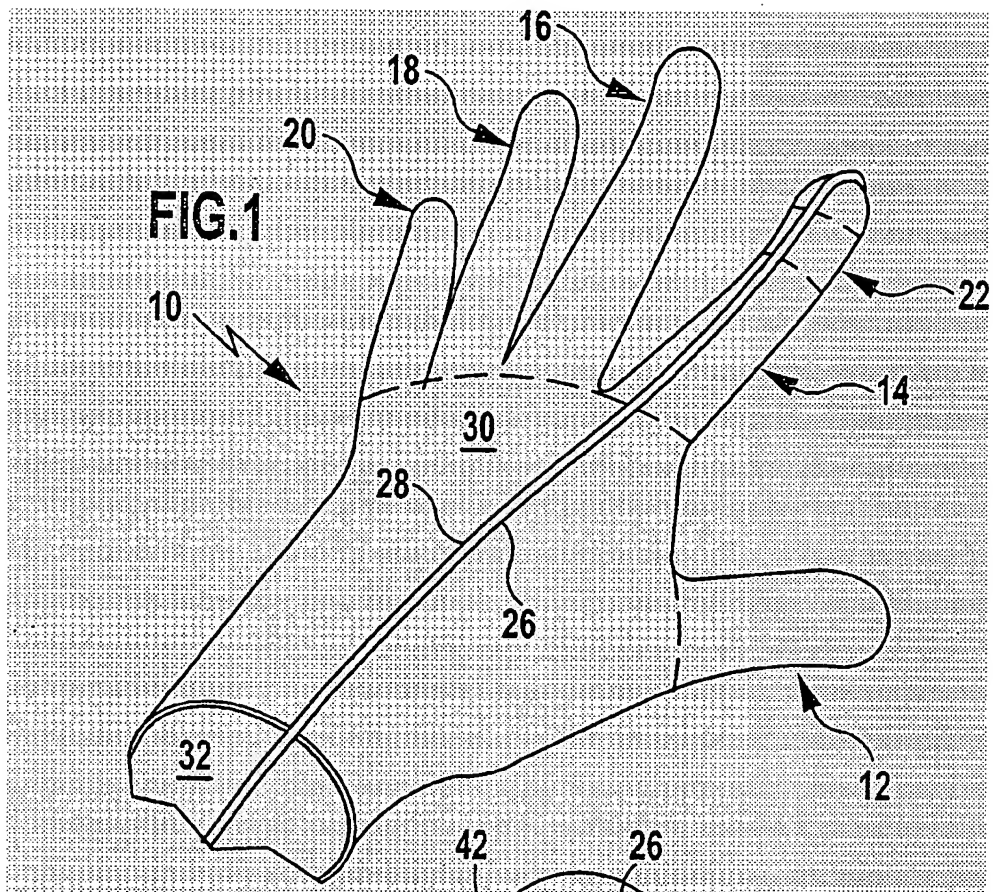
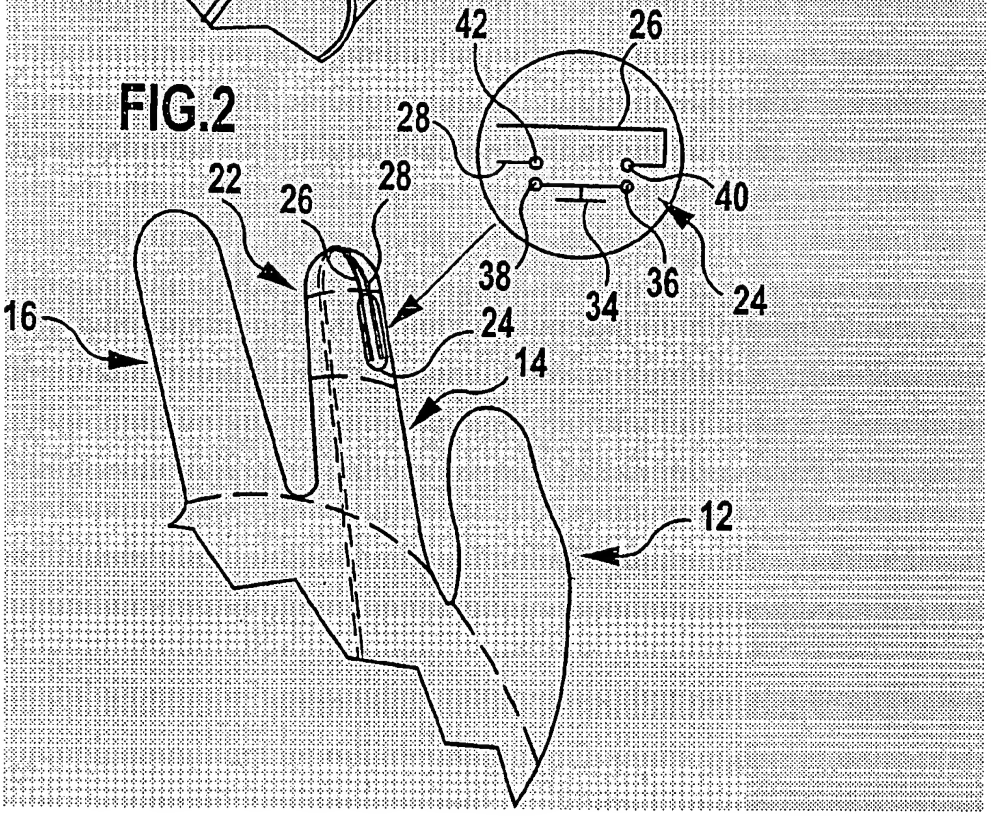


FIG.2



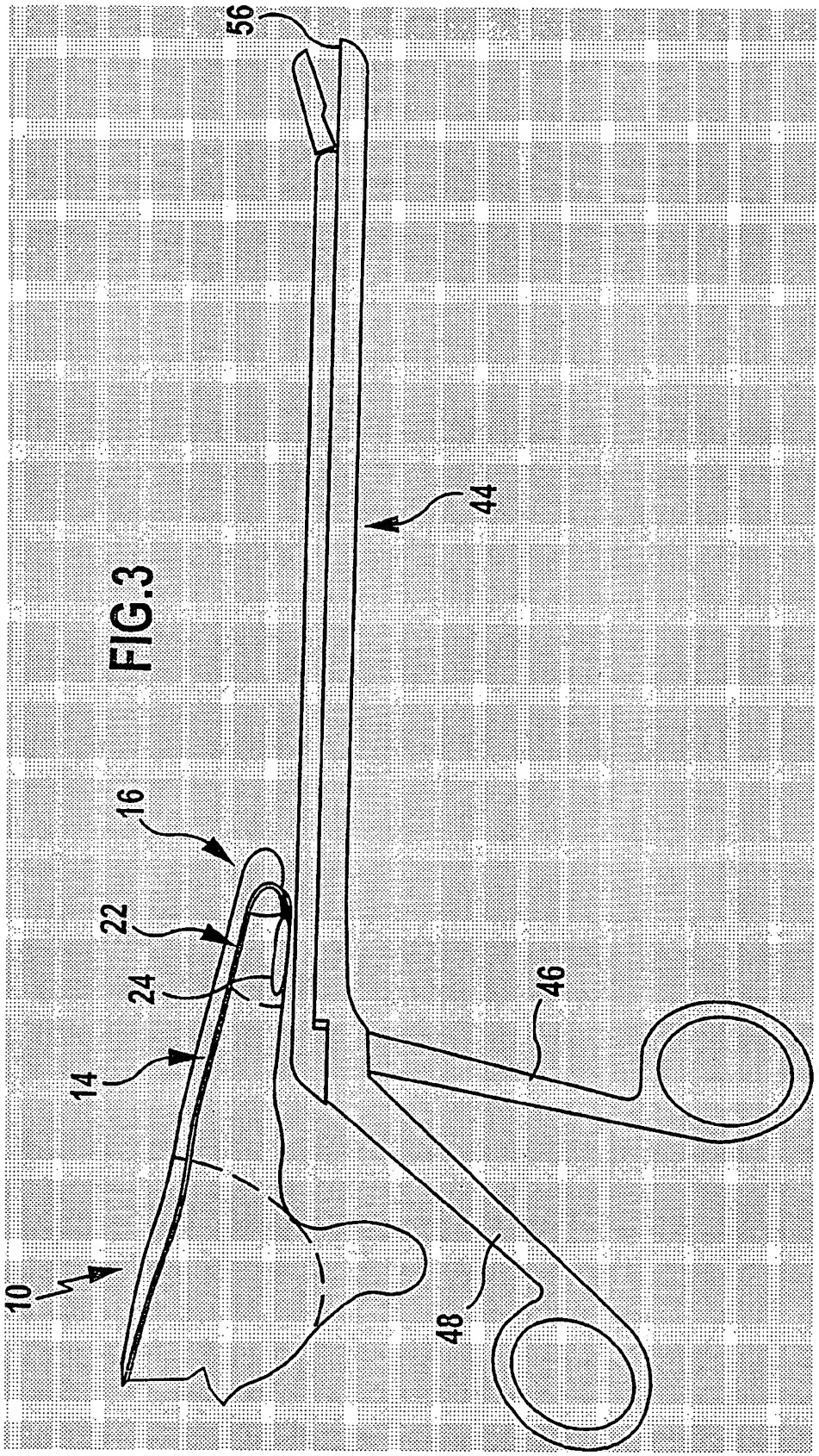


FIG.3

FIG.4

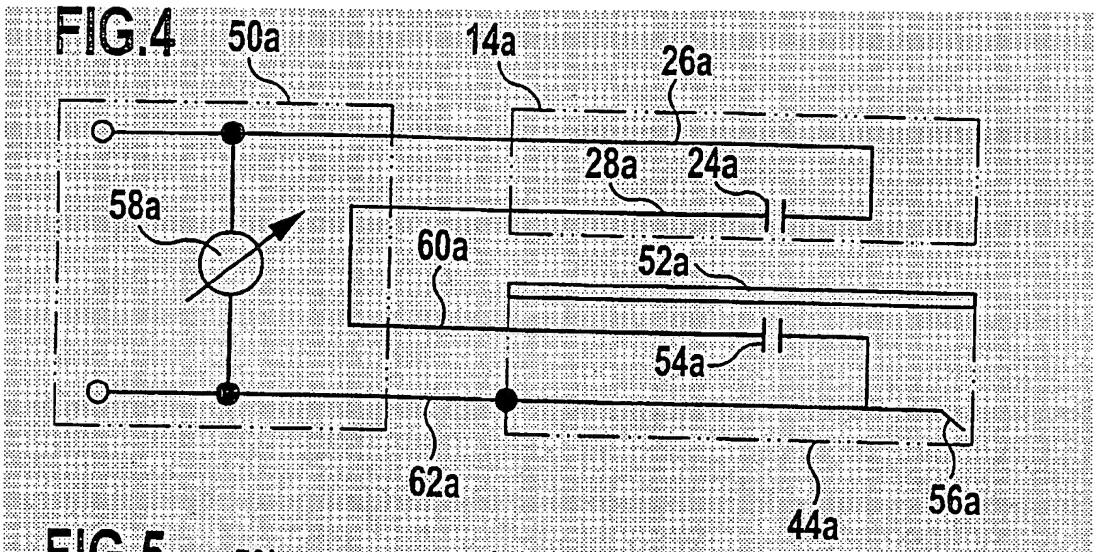


FIG.5

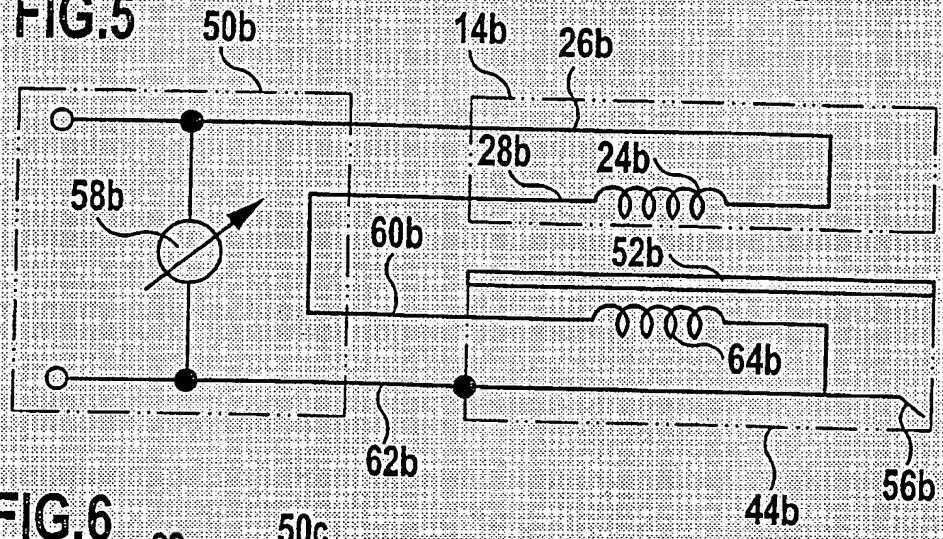


FIG.6